BEFORE THE

Federal Communications Commission

WASHINGTON, D.C. 20554

MM Docket No. 95-17

In the Matter of	)	
	)	
Amendment of Parts 73 and 74 of	)	RM-8109
the Commission's Rules to More	)	
Effectively Protect Radio Astronomy	)	
Activity on Channel 37	)	

To: The Commission

COMMENTS OF THE NATIONAL RADIO ASTRONOMY OBSERVATORY

The National Radio Astronomy Observatory (NRAO), by its attorneys, hereby submits its comments in response to the Commission's Notice of Proposed Rule Making (FCC 95-35, released February 21, 1995) ("NPRM") issued in this proceeding.

The science of radio astronomy has its origins in the discovery by Karl Jansky in 1932 that the central region of the Milky Way Galaxy was radiating radio waves. With some exceptions, little work was done in this new science until after World War II. In the mid-1950s, with only a few radio astronomy observatories throughout the United States, it became evident that large and expensive equipment would be needed in developing radio astronomy. The National Science Foundation (NSF) was approached for funding and after feasibility studies were conducted, the NSF contracted with Associated Universities, Inc. (AUI) to build and operate the National Radio Astronomy Observatory. AUI, a non-profit corporation organized in 1946, is sponsored by nine major universities: Columbia, Cornell, Harvard, Johns Hopkins, Massachusetts Institute of Technology, Pennsylvania, Princeton, Rochester and Yale.

The NRAO currently oversees three radio astronomy observatories in Green Bank, West Virginia, Socorro, New Mexico and on Kitt Peak near Tucson, Arizona. The Kitt Peak NRAO telescope is a millimeter-wave instrument used to study galactic molecular matter which radiates in the microwave spectrum, with some wavelengths shorter than one centimeter. Near Socorro, New Mexico, the NRAO operates the Very Large Array radio telescope (VLA) consisting of 27 interconnected reflector antennas

which are placed on a Y-shaped path. Data from these antennas are combined in a central computer producing results which are very fine and precise. NRAO also operates a Very Long Baseline Array (VLBA) consisting of ten automated 25-meter radio telescopes at ten sites across the United States and its territories, from Mauna Kea, Hawaii to St. Croix, U.S. Virgin Islands. Data from each antenna are combined in a specially designed digital computer system allowing the synthesis of a single radio telescope 8000 kilometers (5000 miles) in diameter, the largest dedicated telescope in the world.

Four major telescope systems are operated at NRAO's Green Bank, West Virginia site and construction of a fifth telescope is nearing completion. The first system is a 140-foot diameter radio telescope which is designed to receive signals between the frequencies of 25 MHz and 35 GHz. It is the largest equatorially-mounted telescope in the world. The second system is an 85-foot diameter telescope which is primarily used in combination with radio telescopes in Florida, Hawaii and Alaska as a time-keeping mechanism. The third system consists of two 85-foot diameter antennas which are united by fiber optic cable into a single telescope called an interferometer. A 45-foot telescope which is sponsored by NASA and which will be used as a link with radio telescopes in space, principally those on Japanese and Russian spacecraft, is the fourth system. Finally, a new telescope which replaces a collapsed 300-foot diameter telescope is expected to be completed in 1996, and will operate between 25 MHz and 120 GHz. When completed, it will offer major advances in radio telescope design and research and is being built with a $75 million appropriation from Congress. All of the Green Bank telescopes are located within the National Radio Quiet Zone, a 13,000 square mile area created by the FCC "in order to provide maximum practicable protection from interference to radio astronomy measurements." Report and Order in Docket No. 11745, 17 R.R. 1738, 1740 (1958).

The Commission's NPRM was issued at the behest of the National Academy of Sciences' Committee on Radio Frequencies (CORF). CORF among other requests urged the Commission to afford protection from broadcast facilities operating on UHF Channels 36 and 38, to 13 radio telescope installations using Channel 37, reserved exclusively for radio astronomy use, which is the equivalent of adjacent channel protection now provided by the FCC's rules for UHF television stations. The NPRM, in which the Commission acknowledges the need for protection against interference to radio astronomy research, proposed to establish a maximum field strength of 64 dBu at the telescope sites from Channel 36 and 38 operators.

The NRAO endorses the Comments being filed by CORF in this proceeding in which it continues to urge adoption of a mileage separation protection scheme rather than

maximum field strength protection. From the standpoint of logic, radio astronomy facilities with receivers tuned to UHF Channel 37 (608 - 614 MHz) should receive the same adjacent channel protection which exists for UHF television broadcasters. Although a field strength limit system of protection may allow more flexibility, it does so only for television broadcasters and not for radio astronomy facilities. Sections 73.687(e)(1) and 74.736(c) and (d) limit spurious emissions (mainly intermodulation products) to -60 dBc (relative to the carrier power) for frequencies above 611 MHz for Channel 36 and for frequencies below 611 MHz for Channel 38. Therefore, a 64 dBu (-82 dB watts/meter ^{2}) carrier level at a radio astronomy site may produce intermodulation within Channel 37 higher than -142 dB w/m^2. This is 43 dB higher (i.e., less protective) than that contained in the Recommendations ITU-R R.A. 769 Table 1 harmful interference level of -185 dB w/m^2 for single antennas and for the VLA radio astronomy antenna system. Such a level of interference within the Channel 37 band renders those frequencies useless for most radio astronomy observations. The 64 dBu limit is slightly higher (i.e., less protective) than the Recommendation ITU-R R.A. 769 Table 3 harmful interference level of -143 dB w/m^2 for the VLBA radio astronomy antenna system. Allowing a television station operating on Channel 36 or 38 with less than maximum facilities to produce a 64 dBu or 72 dBu field strength at a radio astronomy site maximizes the interference level and could very well exceed the level produced at an 87.7 km separation.

Of critical concern to NRAO is the impact of the NPRM field strength limit proposal on its Green Bank operation. Under the interference standards which are currently in use at Green Bank in the National Radio Quiet Zone, the power density limits for the video and audio carriers of Channels 36 and 38 are -170 dB w/m^2 and -185 w/m^2, respectively. These criteria were developed by NRAO which are consistent with international standards and which, if exceeded, would result in significant degradation in the interference environment within the Quiet Zone. The limits were established by taking into consideration demonstrable receiver sensitivities and standards for antenna sidelobe responses (International Radio Consultative Committee of the International Telecommunication Union, or CCIR, Report 224-5), the proximity of the transmitter's radio frequency to a protected radio astronomy band, and the existing interference conditions over which NRAO has no control, such as radiation propagated into the Quiet Zone by the ionosphere. Implementation of the proposed 64 dBu limit, or -82 dB w/m^2, is substantially less protective and would adversely affect the NRAO's Green Bank operations. For this reason, NRAO respectfully urges that the Commission delete the Green Bank site and its coordinates from this proceeding as set forth in proposed rule

Section 73.613(b). However, the proposed Section 73.613(b) should cross reference to Sections 73.1030(a) and 74.12 of the Commission's rules for all Channel 36 and 38 applicants within the Quiet Zone, where more stringent interference standards are applied.

The Commission should also correct the list of radio astronomy telescope coordinates in the proposed Section 73.317(b) as follows:

Location	N. Latitude	W. Longitude
Kitt Peak, AZ	31° - 57' - 22"	111° - 36' - 42"
Owens Valley, CA	37° - 13' - 54"	118° - 16' - 34"
Mauna Kea, HI	19° - 48' - 16"	155° - 27' - 29"
North Liberty, IA	41° - 46' - 17"	91° - 34' - 26"
Hancock, NH	42° - 56' - 01"	71° - 59' - 12"
Los Alamos, NM	35° - 46' - 30"	106° - 14' - 42"
Pie Town, NM	34° - 18' - 04"	108° - 07' - 07"
Socorro, NM	34° - 04' - 43"	107° - 37' - 04"
Fort Davis, TX	30° - 38' - 06"	103° - 56' - 39"
Saint Croix, VI	17° - 45' - 31"	64° - 35' - 03"
Brewster, WA	48° - 07' - 53"	119° - 40' - 55"

The coordinates for Green Bank, WV, the site which NRAO requests the Commission to delete from the protection standards being considered in this rulemaking proceeding, are also incorrect. The correct coordinates are 38° 25' 59" NL, 79° 50' 24" WL.

Finally, NRAO endorses the proposal to require notification similar to that required by Section 73.1030(a) of the rules. NRAO's experience with this requirement in the Quiet Zone leads it to urge that Channel 36 and Channel 38 applicants proposing to locate less than 87.7 km from the ten radio astronomy telescope coordinates listed above. Prior notice in the Quiet Zone has enabled NRAO to work with applicants to eliminate potential interference by meeting or exceeding NRAO's interference limits and to avoid complications, expense, and delays to all parties which can be created by NRAO objections filed after commencement of broadcast operations. However, under the proposed rules, it is not clear as to what entity should be notified because, in some cases, the radio astronomy sites are operated by different institutions. It may be appropriate to provide notification to the Spectrum Management Office of the National Science Foundation who may then be able to pass the notification on to the appropriate institution.

In summary, the NRAO endorses CORF's proposal to provide for mileage separation protection, rather than field strength protection, to the eleven radio astronomy telescope sites listed above. The twelfth site located in Green Bank, West Virginia, situated within the FCC's National Radio Quiet Zone, should continue to receive protection under Sections 73.1030(a) and 74.12 and with the interference limitation

standards now being applied by the NRAO to other applicants for radio frequency spectrum within the Quiet Zone.

Respectfully submitted,

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CERTFICATE OF SERVICE

I HEREBY CERTIFY that on this 30th day of March, 1995, that I am a secretary in the law firm of Reynolds and Manning, P.A. and that copies of the foregoing "Comments of the National Radio Astronomy Observatory" were deposited with the U.S. Postal Service, first class postage prepaid, addressed to the following:

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